

Development of Standard Reference Material (SRM) 955c Lead in Caprine Blood

The SRM 955 series of lead (Pb) in blood standards has been heavily relied upon for quality assurance of clinical blood Pb measurements. It is estimated that over 300 thousand U.S. children aged 1 to 5 years have blood Pb levels greater than the Centers for Disease Control and Prevention (CDC) recommended level of 10 µg/dL. SRM 955c, the fourth in a series of NIST standards certified for blood Pb concentration, was developed in conjunction with the Trace Elements/Lead Poisoning Laboratory, Wadsworth Center, New York State Department of Health and partially funded by CDC. A unit of SRM 955c consists of four vials of frozen caprine (goat) blood at four concentration levels: a base level and three progressively elevated levels that contain endogenous Pb and other toxic elements of interest. SRM 955c will be used by clinical laboratories and hospitals to evaluate the accuracy of Pb concentration measurements in blood and to validate working or secondary reference materials for Pb in blood analysis.

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Lead is neurotoxic and particularly harmful to the developing nervous systems of fetuses and young children. In 1990 the U.S. Department of Health and Human Services established a national goal to eliminate blood Pb levels greater than 25 µg/dL by 2000, and set a new goal to eliminate blood Pb levels greater than 10 µg/dL in children under the age of six by 2010 [1].

In response to the continued need for a blood-based reference material with accurately certified Pb concentrations, NIST developed SRM 955c Lead in Caprine Blood. The composition of this material differs from previous issues of SRM 955. The first SRM 955 was based on heparinized porcine blood obtained from Pb-dosed hogs. SRMs 955a and SRM 955b were based on bovine blood from Pb-dosed cows. SRM 955c is based on caprine blood obtained from Pb-dosed goats. The hemopoietic system of the adult goat is much closer to that of humans, thus making it a better model for assessing proficiency for erythrocyte protoporphyrin, a biomarker of Pb exposure. Adult goats were dosed with lead acetate to produce blood pools containing Pb physiologically bound to red blood cells (erythrocytes). In addition, the blood pools were spiked with inorganic arsenic, cadmium, inorganic mercury, methylmercury, and ethylmercury. Certified values are provided for Pb and are based on analysis using a high-accuracy ID ICP-MS

method [2]. Table 1 lists the certified values and expanded uncertainties for Pb in the four levels of SRM 955c. Compared to previous issues of SRM 955, the Pb concentration for Level 1 is an order of magnitude lower and represents a true base level. Expanded uncertainties of less than 0.6 % relative were achieved for Levels 2, 3, and 4.



Table 1. Certified values (µg/dL) and expanded uncertainties for lead in SRM 955c.

Level 1	0.424 ± 0.011
Level 2	13.950 ± 0.080
Level 3	27.76 ± 0.16
Level 4	45.53 ± 0.27

SRM 955c is used to validate the accuracy of blood Pb measurements.

Future Plans: Additional analyses will be performed to provide certified or reference values for inorganic arsenic, cadmium, inorganic mercury, methylmercury and ethylmercury.

References:

- [1] Surveillance for Elevated Blood Lead Levels, 1997-2001, <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5210a1.htm>, accessed December 2006.
- [2] Murphy, K.E.; Paulsen, P.J.; Fresenius J. Anal. Chem., Vol. 352, pp. 203-208 (1995).

Impact: Over 2 million blood Pb measurements are performed in the U.S. annually. SRM 955 is heavily relied upon for quality assurance of clinical blood Pb measurements, with over 200 units distributed per year. SRM 955c is the fourth issue of this material. Significant improvements over previous issues have been realized in the material composition, Pb levels, and expanded uncertainties of the certified Pb concentrations.